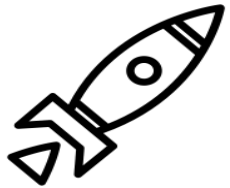
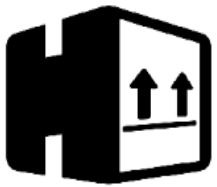
Heat Treatments for Organic Waste Management



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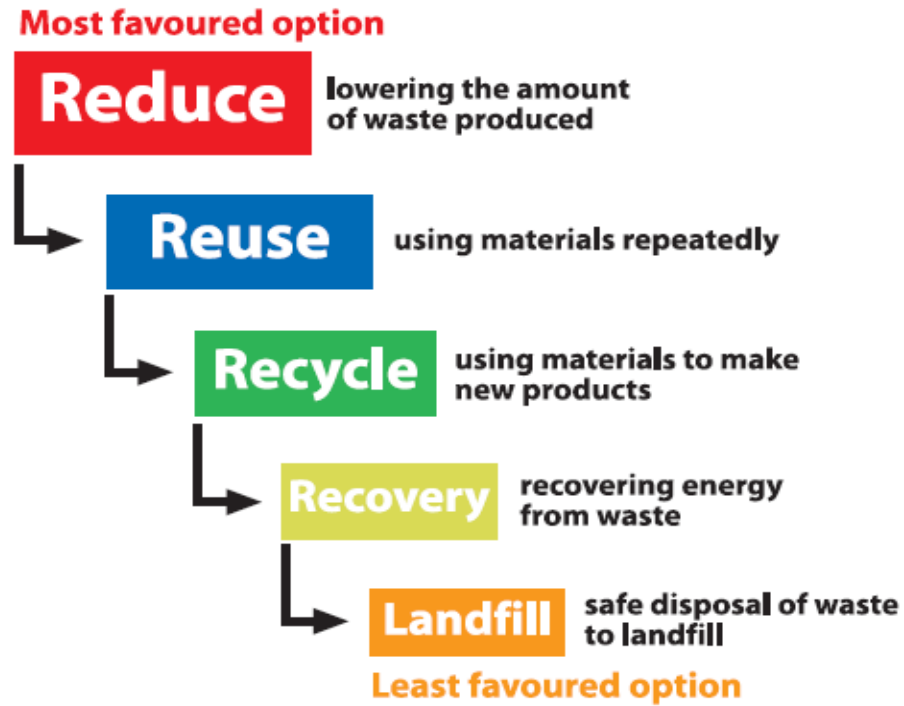
What is Waste Management …

Waste management are the activities and actions required to manage waste from its inception to its final disposal

This includes the collection, transport, treatment and disposal of waste, together with monitoring and regulation of the waste management process

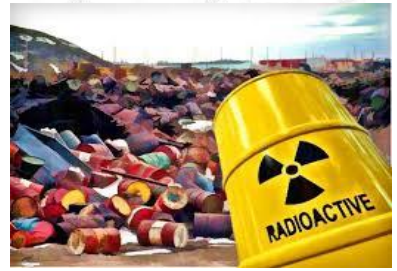
Waste management deals with all types of waste, including Municipal Waste, Medical Waste, Electronics Waste

The Waste Hierarchy



Types of Wastes:

- Municipal Solid Waste
- Organic Waste
- Medical Waste
- Radioactive Waste
- Electronic Waste
- Hazardous Waste



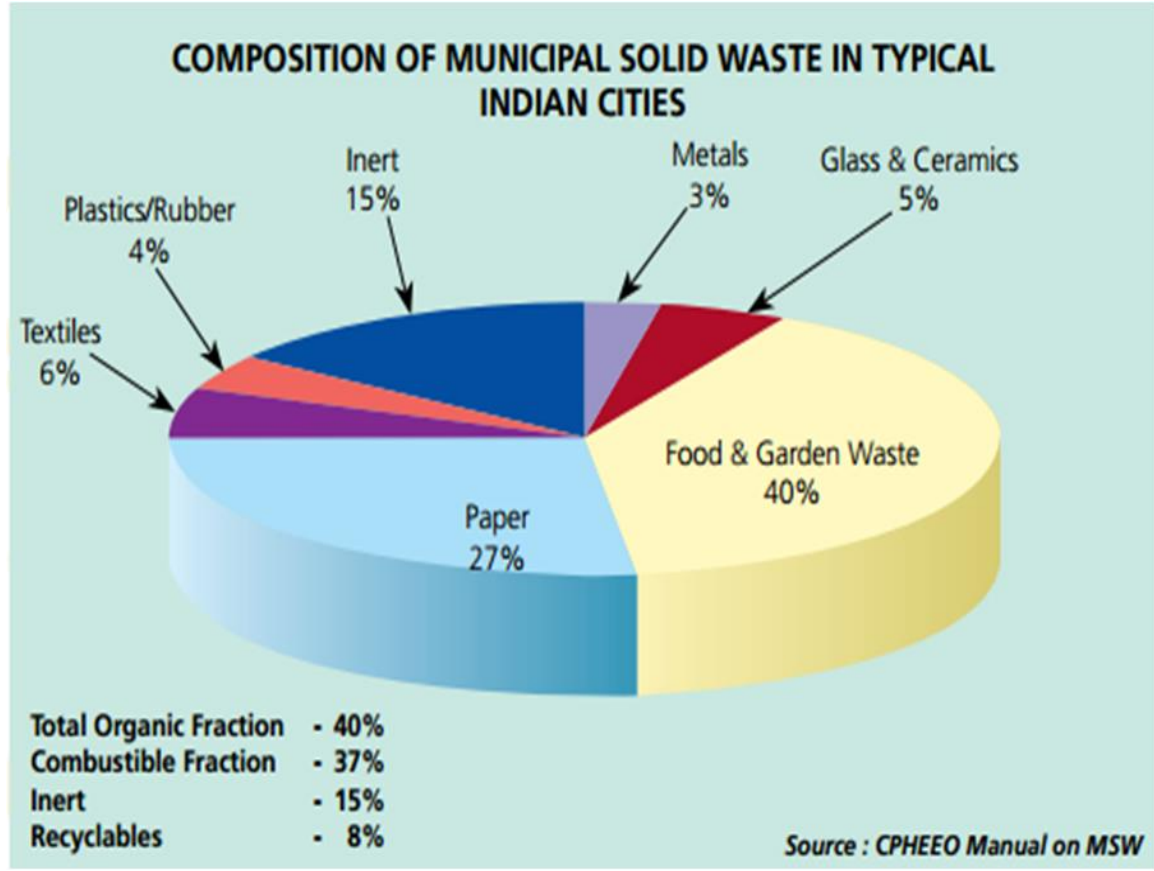
What is Organic Waste ?

Organic waste is any material that is biodegradable and comes from either a plant or an animal. Biodegradable waste is organic material that can be broken into carbon dioxide, methane or simple organic molecules.

It comes in manifold forms – biodegradable plastics, food waste, green waste, paper waste, manure, human waste, sewage, and slaughterhouse waste.

Categories of Organic Waste :

- Industrial Organic Waste
- Agricultural, Forestry and Livestock Organic Waste
- Daily Organic Waste



Industrial Organic Waste


Hospital


Hotel


Restaurant


Market


Food Factories


Wineries


Bio Sludge


Slaughterhouse

Daily Organic Waste


Kitchen Waste


Schools


Organization


Community


Prisons

Agriculture, Forestry and Livestock Waste


Vegetables


Mushrooms


Garden


Farm


Forest


Chicken

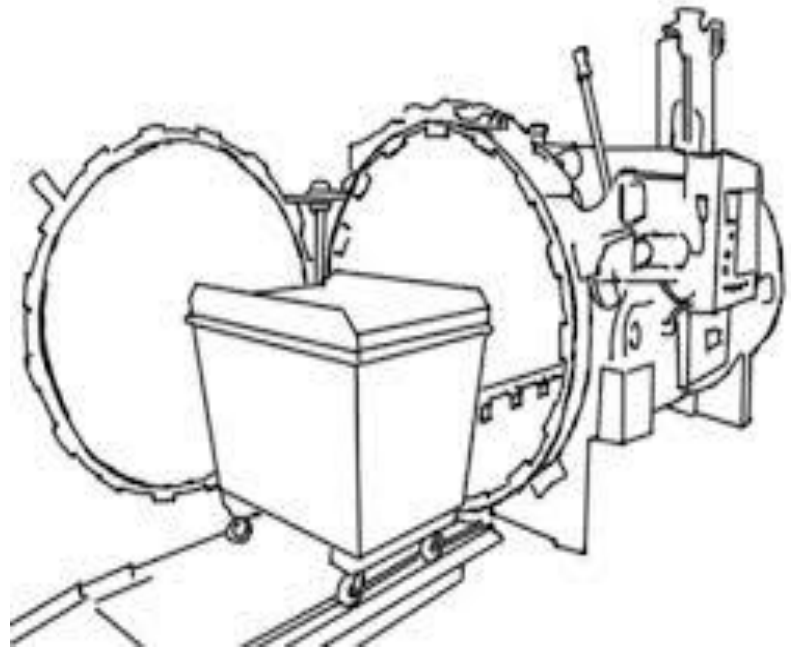

Cattle


Sheep

Classification of heat treatment for organic waste management

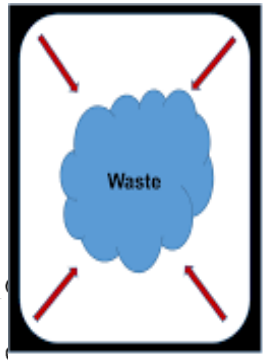
Globally, organic waste is the largest component of hazardous waste. The main disposal method for organic waste is high-temperature combustion in special incinerators and in rotary furnaces. The processes also sanities the waste, by destroying bacteria present, and reduce its moisture content. .

Thermal processes are commonly used for rapid decomposition of organic compounds. The energy utilization from waste can be achieved with the application of different thermal technologies (anaerobic digestion, a biological waste management method, can also result in energy recovery form waste).



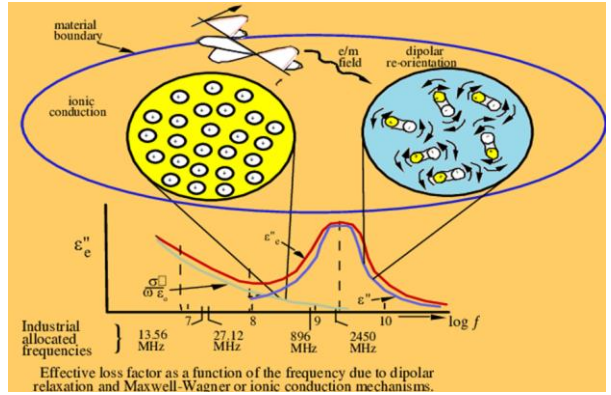
- Treatment of organic waste.
  - Microwave
  - Hydrolysis
  - Gasification
  - Incineration
  - Pyrolysis

Introduction of Microwave Heating

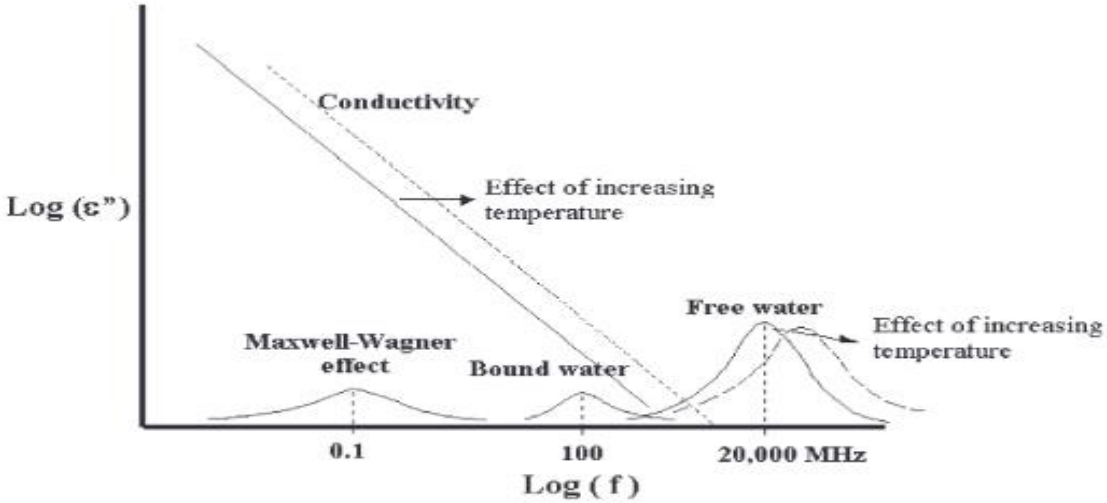


Autoclave

Microwave



Effective loss factor as a function of the frequency due to dipolar relaxation and Maxwell-Wagner or ionic conduction mechanisms.



Microwave heating systems are member of Electromagnetic heating family.

Microwaves has frequency of 2.45Ghz and 950Mhz.

Microwave is generated from small device known as Magnetron.

Microwave heating system has property to heat from within.

Microwave heating systems heats volume of material hence also known as ‘Volumetric Heating’.

Microwave Heat Treatment for Organic Waste Management

A microwave treatment is used to decontaminate organic waste.

These systems work best for waste that is not 100% dry or solid, as the moisture allows the heat to penetrate deeper, and the steam sterilizes.

The microwave unit transmits energy as microwaves and that energy turns into heat inside the wet waste.

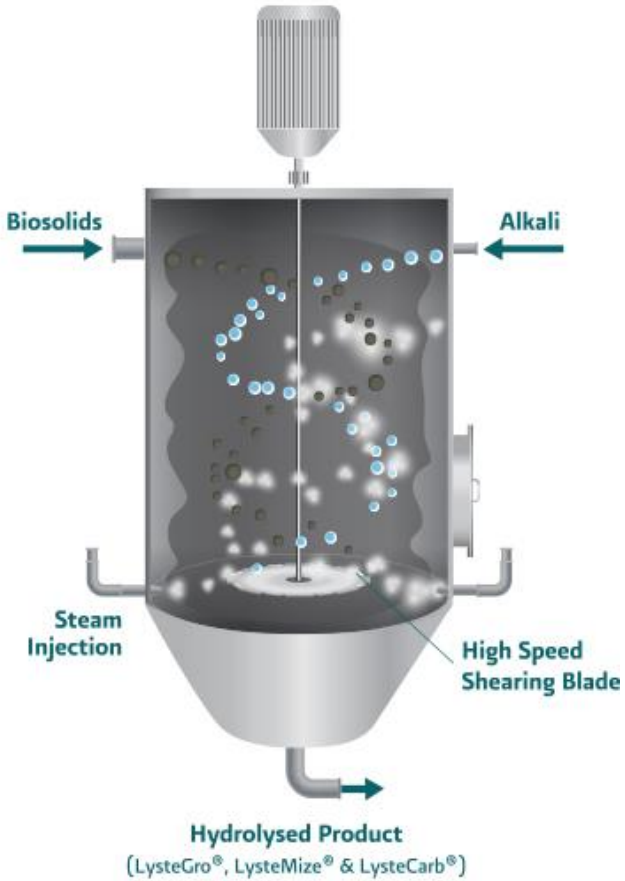
Microwave is a possibility to save energy costs in comparison to the more widely used autoclave technologies, thus leading to a reduced carbon footprint.

The entire process takes place within a single vessel. Bacteriological and virological tests are periodically conducted to ensure the process is effective.

Microwave Heating in Rescue…

Microwave Heating System	Conventional Heating System
Microwave heating system is generates the heat very fast within material.	Conventional heating system have slow hating rate, heat is transferred via means of air.
Heating of materials are due to molecule movements hence no chamber warm up time is required.	Instance heating does not takes place, it requires warm-up of surrounding.
Environmental friendly and green heating solution, no carbon emission.	Produces carbon or toxic gases hence not much environmental friendly heating solutions.
100% energy utilization, as heating takes place within the material.	100% energy utilization is not possible, as material is heated by surrounding hot air.
Better floor utilization index as it doesn't require large chamber area.	Poor floor utilization index as it require bigger chamber area for material to rotate.
No Temperature loss in surrounding, ambient workplace.	Surrounding air temperature rises with rise in heater temperature.

Organic Waste Management using Hydrolysis



Hydrolysis is the process in which cellulose in organic matter is converted to simple sugars (such as glucose). These sugars can then be fermented to ethanol. Cellulose can be hydrolyzed by several means, including acids or enzymes.

In acid hydrolysis, a dilute or concentrated acid is used to hydrolyze the cellulose. Typically, crushed biomass is treated in a dilute acid medium at process temperatures near 460 °F.

Concentrated sulfuric acid may also be used initially to decrystallize the cellulose before the dilute acid process.

In enzymatic hydrolysis, enzymes derived from common fungi are used. Enzymatic processes are commercially unproven, but once improved it is thought that they will have a significant cost advantage over acid processes..

This technology can use food waste such as vegetable and fruit waste as process feedstock.

Gasification of Organic Waste

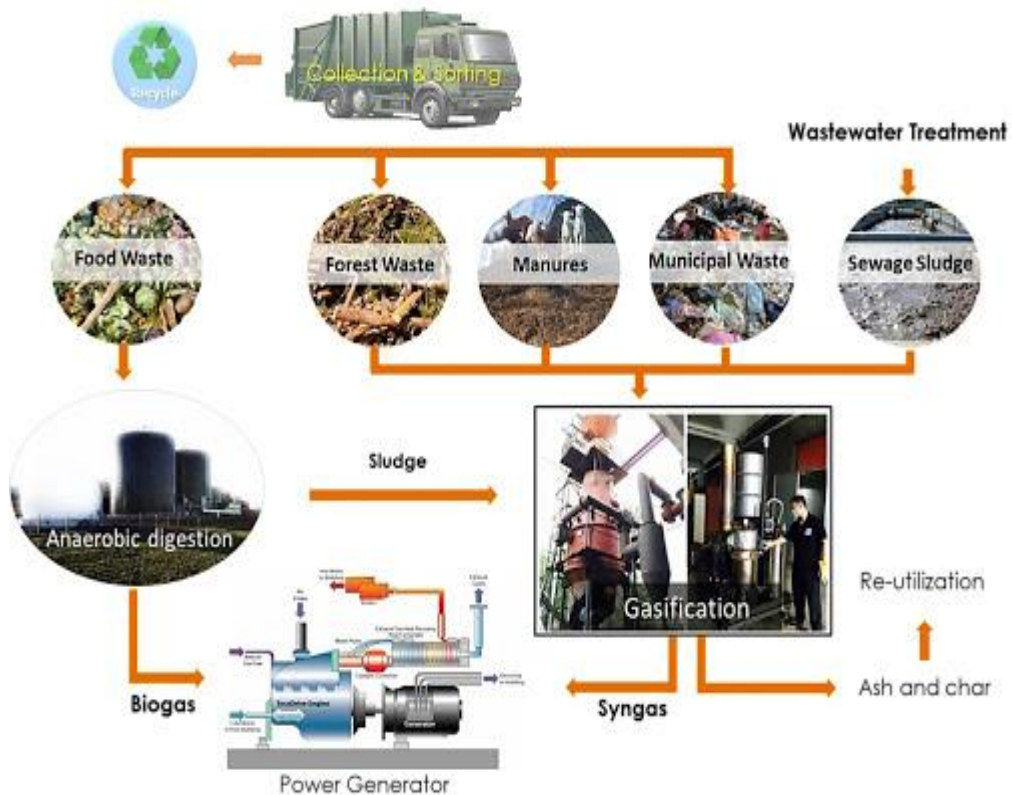
Biomass gasification is a mature technology pathway that uses a controlled process involving heat, steam, and oxygen to convert **biomass** to hydrogen and other products, without combustion.

Gasification is a thermochemical conversion process of carbonaceous materials into gaseous product at high temperatures with the aid of gasification agent.

The gaseous product obtained during this process is called synthetic gas (syngas) or producer gas, and it mainly contains hydrogen, carbon monoxide, carbon dioxide, and methane. Also, a small amount of inert gases, hydrocarbons, tar, and gas pollutants can be found.

Syngas produced from the gasification of MSW can be utilized as a gas fuel being combusted in a conventional burner or in a gas engine to utilize the heat or produce electricity.

Gasification process offers considerable energy recovery and reduces the amount of potential pollutants emission.



Incineration for Organic Waste Management

Incineration is the process of control and complete combustion, for burning solid wastes. It leads to energy recovery and destruction of toxic wastes.

Waste with heating value lower than 3500 kcal/kg is burned in a single-chamber incinerator. Waste is typically heterogeneous, and if the combustible fraction is below 60 percent, it may not be acceptable for incineration.

Incineration can eliminate pathogens - even hard-to-kill bacterial spores - and can reduce the volume and mass of waste that goes to landfills considerably.

Incineration can break down and render harmless hazardous organic chemicals. With proper technology, little acid gas is released to the atmosphere.

Incineration Process

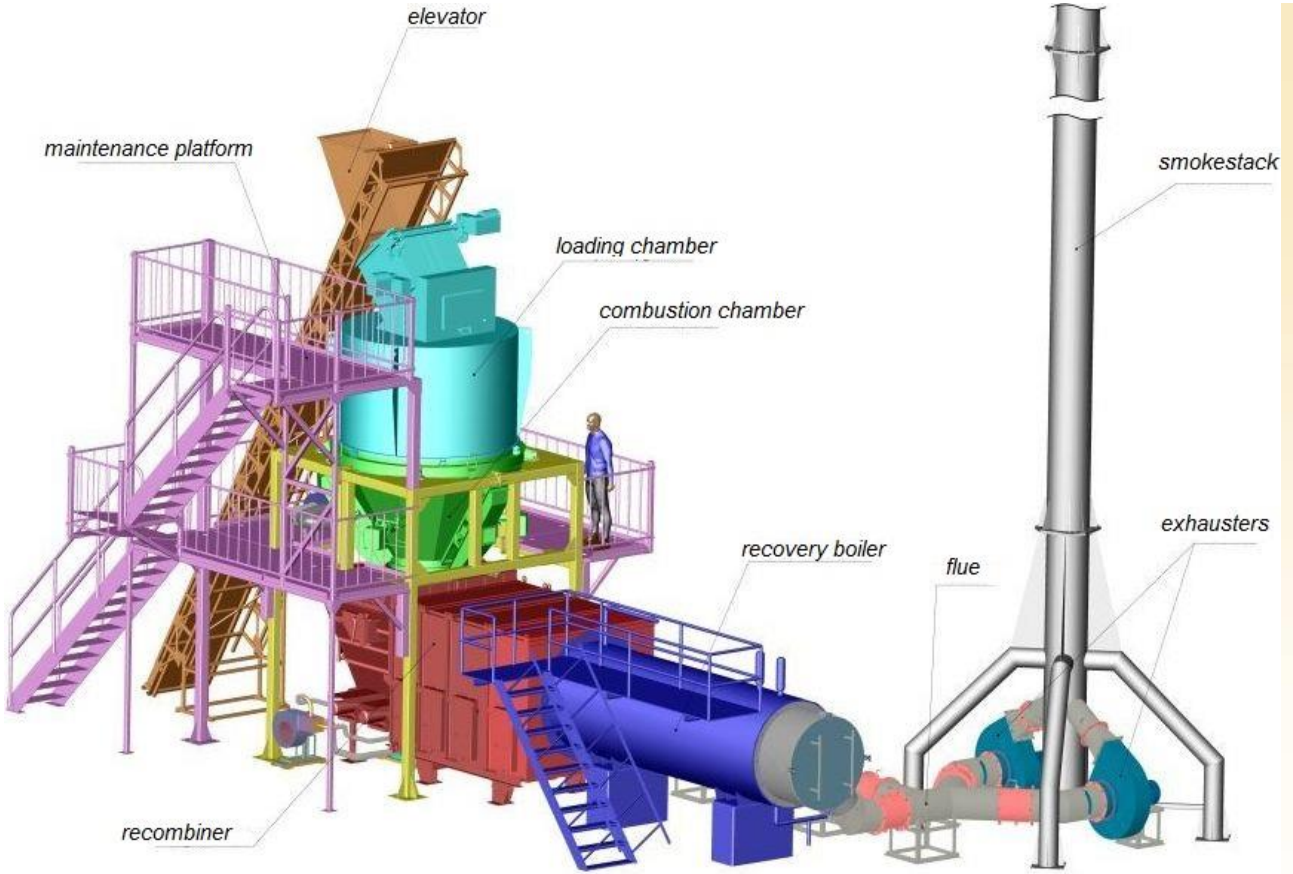
The incineration process is done via a grate system that combusts the waste, which is not refined and is crude. The boilers are equipped with hydraulic rams, which load the waste into an ignition cubicle.

The process involves the combustion of solid waste at 1000°c, it is converted into ash, gas & heat.

The incineration process can be enhanced by the addition of dolomite for controlling acid gas emissions. Waste with high calorific value is suitable for this process.

The incineration process can be applied to almost all organic waste types, including pathological waste, and the process reduces the volume of the waste by up to 90%.

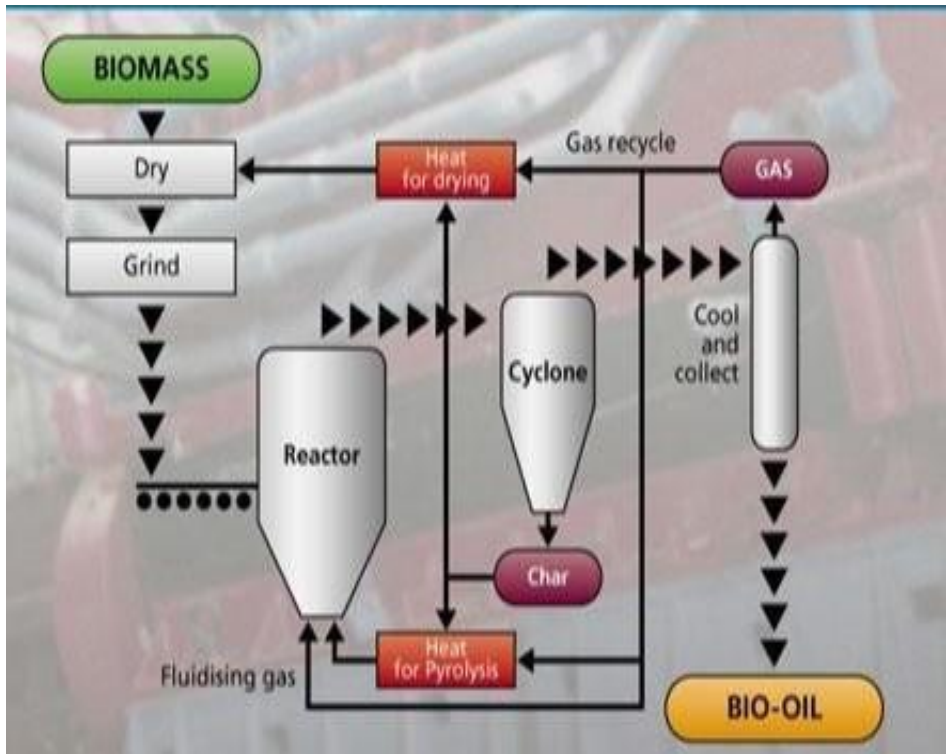
Waste-to-Energy processes, incineration can be used to produce electricity and heat that can be used to power and heat nearby buildings.



Incineration can be useful for…

- **Volume Reduction:** Depending on its composition, incineration reduces the volume of the wastes to be disposed of by an average of 90%.The weight of the solid wastes to be dealt with is reduced by 70- 75%.
- **Stabilization of Wastes**: Incinerator output (ash) is considerably more inert than incinerator input(solid wastes), mainly due to the oxidation of the organic components of the waste stream.
- **Recovery of Energy from Waste:** This represents a valorization method, rather than just a pre treatment of Waste prior to disposal. Energy recovered from burning the wastes is used to generate stream for use in on site electricity generation.
- **Sterilization of waste :** This is of primary importance in the incineration of organic waste. Incineration of municipal solid wastes will also ensure destruction of pathogens prior to final disposal.

Pyrolysis Treatment for Organic Waste Management



Pyrolysis is rapidly developing biomass thermal conversion technology and has been garnering much attention worldwide due to its high efficiency and good eco-friendly performance characteristics.

Pyrolysis technology provides an opportunity for the conversion of municipal solid wastes, agricultural residue, scrap tires, non-recyclable plastics etc. into clean energy.

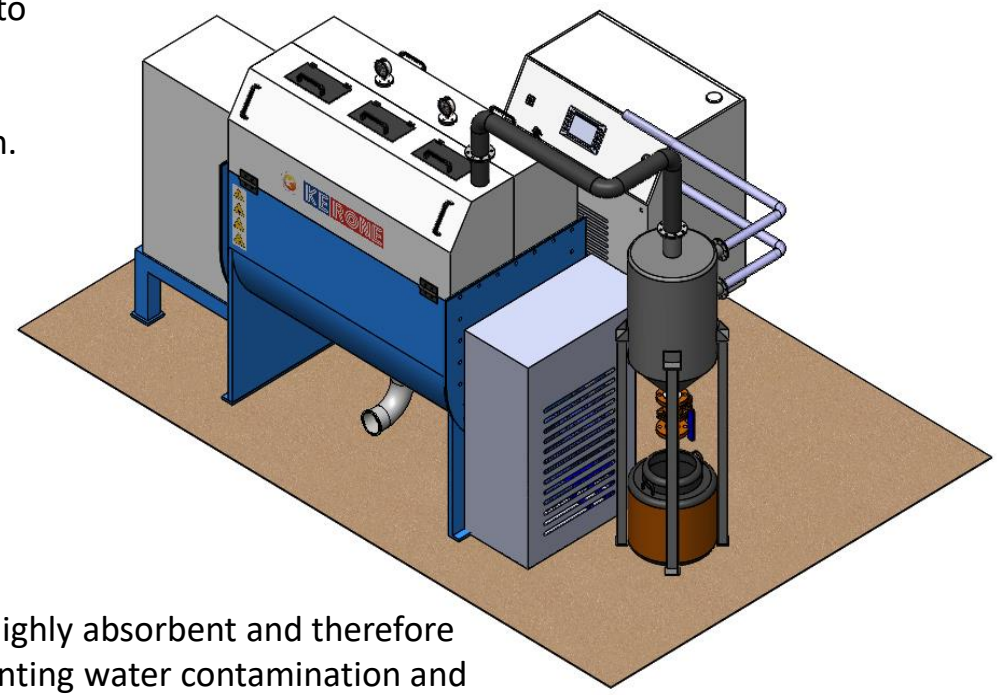
In this method solid waste material is heated in specially designed chamber which is called as pyrolysis reactor. In pyrolysis reactor, heating is carried out in closed environment which is almost oxygen free.

Thermal decomposition of organic components in the waste stream starts at 350°C–550°C and goes up to 700°C–800°C in the absence of air/oxygen.

The main products obtained from pyrolysis of municipal wastes are a high calorific value gas (synthesis gas or syngas), a biofuel (bio oil or pyrolysis oil) and a solid residue (char).

Overview of Pyrolysis Process..

Pyrolysis processes can be categorized as slow or fast. Slow pyrolysis takes several hours to complete and results in biochar as the main product. On the other hand, fast pyrolysis yields 60% bio-oil and takes seconds for complete pyrolysis. In addition, it gives 20% biochar and 20% syngas. Fast pyrolysis is currently the most widely used pyrolysis system.



The essential features of a fast pyrolysis process are:

- Very high heating and heat transfer rates, which require a finely ground feed.
- Carefully controlled reaction temperature of around 500^{o}C in the vapor phase.
- Residence time of pyrolysis vapors in the reactor less than 1 sec.
- Quenching (rapid cooling) of the pyrolysis vapors to give the bio-oil product.

The essential features of a fast pyrolysis process are:

- A wide range of biomass feedstocks can be used in pyrolysis processes.
- The bio-char produced can be used on the farm as an excellent soil amender as it is highly absorbent and therefore increases the soil's ability to retain water, nutrients and agricultural chemicals, preventing water contamination and soil erosion.
- It also provides an opportunity for the processing of agricultural residues, wood wastes and municipal solid waste into clean energy. .
- Biochar sequestration could make a big difference in the fossil fuel emissions worldwide and act as a major player in the global carbon market with its robust, clean and simple production technology..

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